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STUDIES WITH ARTIFICIAL FEVER IN EXPERIMENTAL TUBERCULOSIS[1]

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During the past three years studies of the effects of artificial fever on the cellular equilibria in experimental animals have been conducted in the laboratories of the Department of Medical and Surgical Research, Ohio State University, with a high frequency, short wave radio-therm constructed and serviced by Professors Dreese and Byrne of the Department of Electrical Engineering.

That artificially induced fever effects beneficially certain diseased states in man has been rather clearly and definitely demonstrated in recent years. The present task of those interested in this approach toward a better mobilization of the immune forces of the body is to reveal the mechanism or mechanisms by which this desired end is accomplished and to differentiate those conditions in which such therapy may be contraindicated.

There are three avenues by which fever might prove beneficial in combatting infectious disease: (1) by the actual destruction or attenuation of the infecting agent, the thermal death point for the pathogenic bacteria being lower than that for the host cells; (2) by enhancing the development of humoral antibodies; or (3) by stimulating a more effective mobilization of the phagocytic cells of the blood and tissues; or, of course, any combination of these three effects may be hypothesized.

Among those infections mentioned as possibly susceptible to the beneficial results of hyperpyrexia has been tuberculosis. Duncan and Mariette (1) reported the attenuation in vitro of acid fast strains of organisms at human fever temperatures.

[1]Read before the Ohio Academy of Science, April 18, 1935.

Professor W. A. Sterin, of the Department of Bacteriology, however, who has carried on similar studies in co-operation with our group has been unable to demonstrate either lethal or virulence altering effects of fever temperatures upon any of the acid fast group of pathogenic organisms studied under in vitro conditions.

The present report deals with certain observations made in rabbits experimentally infected with virulent tubercle bacilli and subjected to repeated "feverings." Two kilogram rabbits were selected and inoculated with a thirty-day culture of Bovine B-1, undissociated acid fast organisms. Baseline observations for a period of at least two weeks were made on all animals prior to inoculation. Total white cells, supravital differentials, total red cells, and hemoglobin were determined and weights and temperatures were recorded six times during this period. Chest X-rays were made of all animals, and the animals selected for fevering were subjected to a preliminary heating in the radiotherm before inoculation.

A single fevering, in this experiment, consisted of placing one animal at a time, in the radiotherm, and exposing it to a radio frequency of four thermo-ameters, 25 meter wave length, 12,000,000 oscillations per second, for approximately twenty minutes, during which period the rectal temperature rose from 102° to 107°–108° F. This temperature was then maintained by a continuous flow of from 1–2 thermo-ameters, for a period of one hour. At the end of this time the animal was removed from the set and its temperature allowed to return to normal under room conditions. Temperature changes in the animal were followed at intervals of ten minutes while in the radiotherm and every thirty minutes thereafter until the temperature had returned to normal. Blood counts and weights were taken before the rabbit was placed in the set, at the end of one hour of fevering and again when the temperature had returned to normal. The animals selected for fevering were subjected to this elevation of temperature twice a week until death intervened or the observations were terminated. X-rays of the chests of all animals were taken every twenty days. Blood, temperature, and weight changes were followed throughout the experiment, on all animals, at intervals comparable to those established during the base line period.

In the first experiment, fourteen animals were selected for observation. Seven of this group were injected with 0.1 milli-

gram of the Bovine culture, intravenously. Six others received 0.2 milligrams intratracheally. One animal was not inoculated, and served as a normal fever control.

Four animals of the first group and three of the second group were selected for fevering. Fever therapy was begun twenty days after the inoculations. The chest X-rays, taken at this time, showed definite pulmonary lesions. The blood picture also was typical of tuberculous disease (2, 3). The animals injected intravenously survived only one or at most two feverings; the disease process was so acute and the pulmonary congestion so great, that the vital capacities in these rabbits were insufficient to support the added cardiac and respiratory demand during fever treatment. Tuberculous controls inoculated at the same time but not subjected to fevering were killed at the time the others died. At autopsy, all animals showed gross lesions in practically all organs of the body. Gross hemorrhages were found in all of the fevered animals and in but one of the controls. In this group, the amount of the fever therapy was of necessity so limited by the acuteness of the tuberculous process which developed, that it was impossible to draw any conclusions. There is no question but that animals in such a serious and far advanced condition cannot survive an elevation of temperature to the degree mentioned (107–108° F.).

Of the group injected intratracheally, one animal survived three feverings, another eight, and the third nine. The non-fevered controls all outlived the fevered group and were killed by air embolism for comparative autopsy study.

The blood studies showed a definite reversal of the M–L ratio (4, 5) in the fevered animals, in contrast to the non-fevered controls. At postmortem, the dissemination of organisms appeared greater in the fevered group, as indicated by the extent of gross lesions. All fevered animals showed definite gross hemorrhages particularly in the thymus. The normal animal was fevered nine times, and showed no significant cellular changes in the peripheral blood. The weight and temperature of the normal animal remained within normal limits. This animal was not killed at this time but was fevered repeatedly throughout the subsequent experiment as a control.

The above observations indicated the necessity for further study on animals with a less fulminant tuberculosis.

For the second experiment, six animals were selected. Baseline observations were made as indicated above. All of

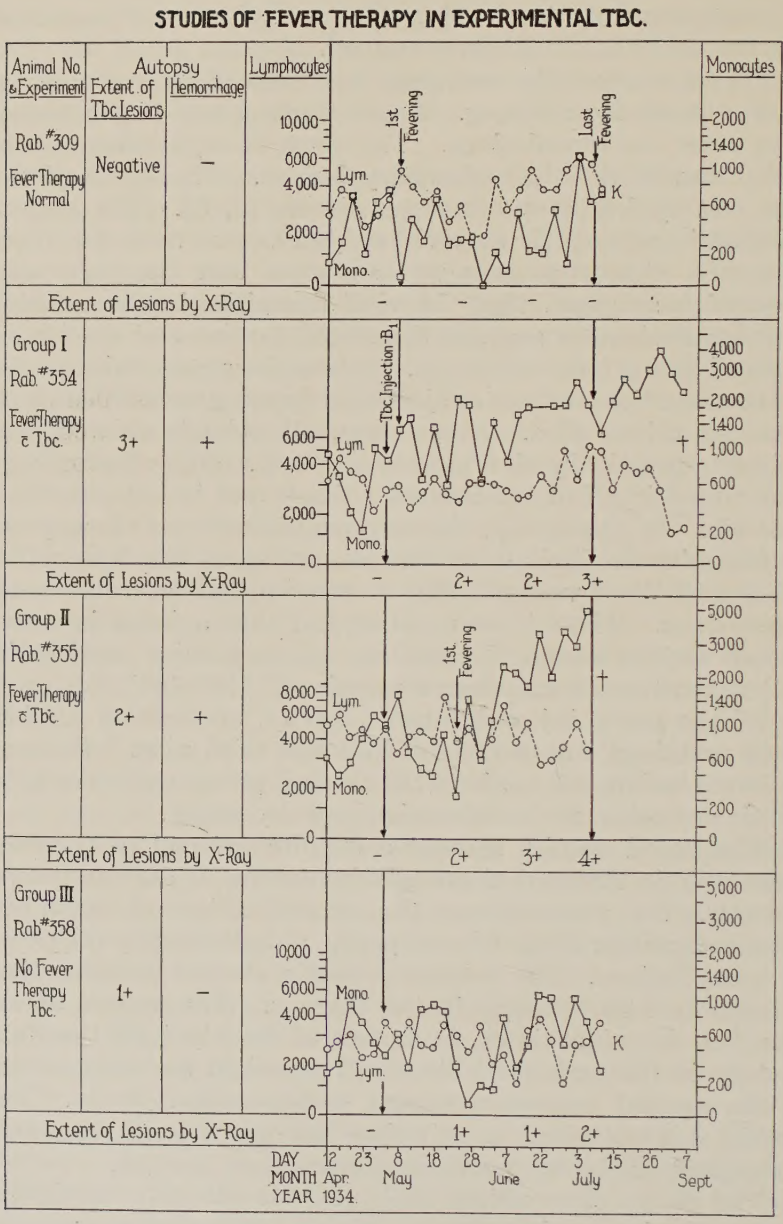
STUDIES OF FEVER THERAPY IN EXPERIMENTAL TBC.
Animal No. & Experiment
Autopsy
Extent of Tbc. Lesions
Hemorrhage
Lymphocytes
Monocytes
Rab. #309
Fever Therapy
Normal
Negative
–
1st. Fevering
Last Fevering
Lym.
Mono.
K
Extent of Lesions by X-Ray
Group I
Rab. #354
Fever Therapy & Tbc.
3+
+
Tbc. Injection B1
†
Group II
Rab. #355
Fever Therapy & Tbc.
2+
+
Group III
Rab. #358
No Fever Therapy Tbc.
1+
DAY
MONTH Apr. May June July Sept.
YEAR 1934.

CHART I

these animals were inoculated intratracheally with one-fiftieth milligram of the Bovine B-1 Culture. Two of this group were fevered, beginning three days after inoculation; two others were started twenty days later, and a third group of two was held as tuberculous controls without artificial fever. The normal animal was fevered with this group. Fever was induced two times a week. The animals in Group I were fevered a total of seventeen times. The animals in Group II started twenty days after injection and were fevered twelve times. The animals in Group III received no fever therapy. The normal control was fevered seventeen times in this experiment, a total of twenty-six times during the two experiments.

The chest X-rays were negative on all of the animals before inoculations were made. The extent of the lesions after twenty days was estimated two plus in Groups I and II, and one plus in Group III. Forty days after inoculation, Group I manifested evidence of two plus lesions, Group II three plus lesions, and Group III only one plus. Sixty days after the inoculation, Group I showed three plus lesions, Group II four plus lesions and Group III two plus lesions. X-rays on the normal control were uniformly negative.

One animal from each group, and the normal control were killed at the end of this period of nine weeks. At autopsy, the dissemination of organisms was estimated by the extent and the gross distribution of tuberculous lesions in various organs. The first group showed a three plus dissemination. Group II showed a two plus, and Group III only one plus; that is, tubercles were found only in the lung. Pin point hemorrhages were observed in the thymus glands of the animals in Groups I and II. There were no remarkable temperature or weight changes during this period, in any of the animals. (Slight weight decrease in three out of four fevered animals.) The changes in monocytes and lymphocytes, however, were striking. Chart I shows the relative and absolute changes in the M/L ratio, as found during the course of the experiment in one animal from each of the different groups. With the first induction of artificial fever—regardless of the duration of the disease—a sharp reversal of the M/L ratio in the circulating blood was precipitated. It has been shown (2) and amply confirmed that the M/L ratio in the blood is an accurate index of new tubercle formation in the tissues in tuberculous disease. A persistently rising monocyte curve and a steadily falling

lymphocyte count is of bad prognostic significance. Following the marked vasodilitation and hyperventilation induced by fever therapy an increased dissemination of the disease occurred, reflected most sensitively and accurately by these blood cell changes. The figures from the fevered animals charted on the graphs were taken from the blood counts obtained just before each fevering.

The blood changes occurring in the animals in Groups I and II, kept for longevity studies, continued to reflect an acute tuberculous course, terminating in death, approximately two months after the others were killed. The tuberculous non-fevered control animal survived a longer time with much less change in the blood picture. The degree of dissemination of the disease as indicated by gross lesions, was in the same proportion, in these animals, as in the animals that were killed previously. The microscopic findings were consistent with the gross observations made at the time of autopsy.

The acute blood changes which occurred during the actual fevering were especially interesting from the standpoint of the monocytes and lymphocytes. There was a marked initial depression of circulating cells, both in the tuberculous and in the normal animals during fever. This was followed by a decided monocytic leucocytosis in the tuberculous rabbits only, as the temperature returned to normal. This reaction may be compared to that reported by Geiger (6) upon the injection of colon bacilli into tuberculous as contrasted with normal guinea pigs. The reaction to artificially induced fever, like that to colon bacilli, reveals an excessive tissue storage of monocytes in tuberculous animals, the result of the specific tuberculo-lipoid effect and the tubercle formation (4).

CONCLUSIONS

1. Rabbits with primary pulmonary tuberculosis cannot long survive an artificially induced elevation of temperature to 107°–108° F.

2. There is more rapid and extensive lung involvement as shown by X-ray and post-mortem studies in animals that are fevered than in those that are not fevered during the course of the disease.

3. There is a definite increase in dissemination of organisms in fevered rabbits as evidenced by a prompt reversal of the M/L

index in the blood, by a wider distribution of gross tubercles and by the greater tendency to hemorrhage.

4. Similar elevations of temperatures at repeated intervals in a normal non-tuberculous animal produced no significant alteration in the cellular relationships in the blood or tissues.

5. The blood changes and the physical findings in these experiments suggest a definitely harmful effect of fever therapy in rabbits with primary tuberculosis of bovine type.

6. On the basis of these studies, no human patient with tuberculous disease has knowingly been treated with artificial fever therapy by our group.

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New England Geology

Almost twenty years ago the original manuscript of this work was prepared for publication. Various causes contributed to the long delay in publication, during which time the senior author died. Most of the field work was completed in 1914–1915. The work is divided into three parts. The first considers the region as a whole and develops a correlation with the glacial geology of Long Island as worked out by M. L. Fuller (U. S. Geol. Survey Professional Paper 82, 1914). Four glacial stages are described tentatively correlating with the four glacial advances in the Middle West. This is not in keeping with the three generally recognized stages in the New York State Area. Needless to say, most of the work deals with the Pleistocene, as Pre-Pleistocene exposures are few and far between in the region. The Pre-Cretaceous basement is mentioned but as it does not really enter into the geology it is not discussed at length.

Part II is devoted to "Geology of Particular Areas." The general plan of procedure in these chapters is the geography, the geology and a bibliography of the area. Here are taken up Nantucket and adjacent islands; Martha's Vineyard, No Man's Land, and Block Island.

Part III is devoted to the geology of Cape Cod and the Elizabeth Islands.

The paleontology and paleobotany are handled by others than the two authors. Twenty-three text figures and 38 plates greatly increase the value of this work. Six of the plates are geologic maps showing exposures as they were in 1914–1915, allowing future investigators to visit their localities and exposures. Everyone studying the Pleistocene must of necessity become familiar with this excellent piece of work.—WILLARD BERRY.

Geography and Geology of the Region Including Cape Cod, the Elizabeth Islands, Nantucket, Martha's Vineyard, No Man's Land, and Block Island, by J. B. Woodsworth and Edward Wigglesworth. xvi+322 pp. Cambridge, Memoirs Museum of Comparative Zoology, Harvard College, Vol. 52, 1934.

THE BLACK HAND FORMATION IN NORTH CENTRAL OHIO

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The Mississippian series in central Ohio consists of a series of alternating sandstones and shales, the thin vein of the Maxville limestone being absent. These are more generally known as the Waverly. The epeiric basin in which they were deposited was unquestionably subject to variation in water currents and consequently a fine grained sandstone or a freestone and a shale may be found in the same facies at no great distance apart horizontally. On this account the correlation of the various subdivisions into which the Mississippian series in this area may be divided is difficult.

Between the Berea grit, a persistent sandstone which is near the base of the Mississippian, and the Pennsylvanian, another sandstone which has been given the name of the Black Hand from the narrows of the Licking river, east of Newark, where there is an exposure two miles long in an east-west direction, persists from the Ohio River northward to some distance north of Mansfield. This sandstone has been traced from the Ohio river to the Licking river, in southern Ohio by Hyde.[1] The horizon of this sand is known to the oil driller as the Big Injun and the sandstone is found in most well records in eastern and southeastern Ohio.

North of Newark, where the surface has not only been subject to the erosion of two ice sheets, but is covered with glacial till to varying depths, the present outcrops are fewer and the former extent of this sandstone must be determined with the aid of well records, both water and oil.

The Black Hand is a coarse, sharp sandstone with varying binders. In some localities the sandstone is gray, comparatively free from iron, and easily crushed into a good grade of glass-sand; in other localities the color is a light buff and is quarried for building stone. The general characteristic is its coarseness, sharpness and the frequent presence at various levels of a quartz pebble conglomerate, the pebbles varying

[1]Jour. Geol., Vol. XXIII, p. 665 seq.

in different localities from a maximum of one to one-quarter inch in diameter. The outcrops of the sandstone in this area vary from 20 to 70 feet in thickness, though some well records indicate a greater local thickness.

Another characteristic of the Black Hand, in which fossils have not been found, is the presence from five to thirty feet above its top, of a shale and fine sandstone strata that is fossiliferous. This is always found except in localities where erosion has removed the higher strata.

Fig. 1 is a map of the area from Licking to Richland and Ashland counties, on which are marked the outcrops, quarries and some well records of the Black Hand sandstone. The various locations are numbered on the map and the elevations of the top of the sandstone above sea level indicated. These outcrops are briefly described:

1. Black Hand Narrows of Licking river, Hanover twp., Licking county; forty foot exposure, ten feet containing quartz pebbles.
2. Pennsylvania railroad cut, one mile east of Hanover village, Hanover twp., Licking county; twenty-five foot section.
3. Rain Rock, Eden twp., Licking county. The Black Hand outcrops also on Rocky fork, west of Rain Rock.
4. Abandoned stone quarry on top of hill, one mile south of Utica, Washington twp., Licking county; twenty-five foot section exposed.
5. Along bank of Wakatomika creek, sec. 24, Jackson twp., Knox county; thirty foot section exposed, one-quarter to one inch conglomerate about the middle.
6. Rocky Hollow and Millwood Sand Co. quarry, along Kokosing river, two miles southeast of Millwood, Union and Butler twps., Knox county; 40 foot section exposed, quartz pebbles in three feet of section, western part of outcrop.
7. Water wells in glacial till, near Polk school and Weaver school, Liberty twp., Knox county; the drilling records show 30 and 130 feet, respectively, to rock, which places top of sandstone in both wells at 1,260 feet and indicates that strata above Black Hand had been eroded prior to or by glaciation.
8. Keller's Rock, southwestern part sec. 8, Pike twp., Knox county, along Little Schenck creek; 20-foot exposure, five feet of which contain one-quarter inch quartz pebbles.
9. Quarry, north of state road 97, sec. 13, Jefferson twp., Richland county; fifteen feet sandstone exposed.
10. Clear Fork, Mohican river, sec. 7, Hanover twp., Ashland county; Lyons Falls is an overhanging sandstone ledge fifty feet high, with concave under surface, similar to Ash Cave, Hocking county; sixty feet exposed, one-half inch quartz conglomerate near bottom. These exposures of the Black Hand are in the upper part of Mohican State Park.

county the interval is about 2,250 feet, the distance being about 22 miles.

If the facies from the top of the Black Hand to the Berea

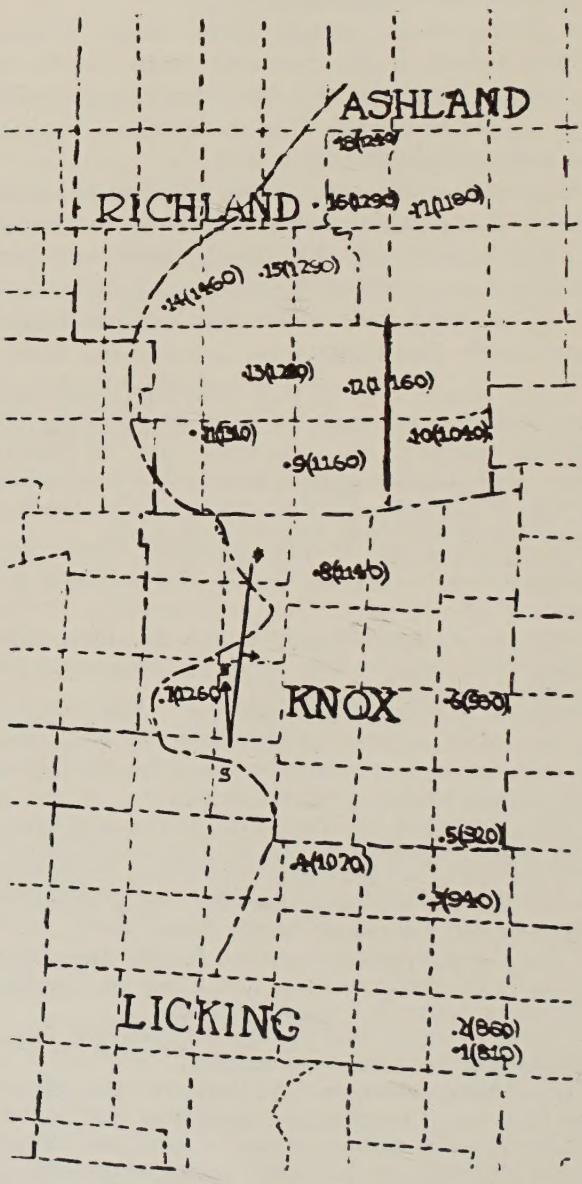

FIG. 1. Axis of the Dip of the Black Hand. Western Extent of the Black Hand.

11. Water well, west sec. 1, Perry twp., Richland county; elevation of well head 1,320 feet, 11 feet to sandstone, rock more than 160 feet thick.
12. Along Switzer creek, sec. 34, Monroe twp., Richland county; 25 feet exposed, one inch quartz pebbles at top, one-eighth inch conglomerate through entire section.
13. Opossum run, east sec. 16, Washington twp., Richland county; forty feet exposed, twenty-foot waterfall, concave "cave" behind fall.
14. Quarter mile northeast of elevation 1,500, sec. 34, Springfield twp., Richland county; coarse grey sandstone with quartz pebbles, fifteen feet exposed. This is the second highest area in Ohio.
15. Old stone quarries, sec. 15, Madison twp., Richland county, north of Mansfield, near state reformatory; sixty-foot section, no conglomerate.
16. Old stone quarry, north of Pavonia school, sec. 31, Weller twp., Richland county; fifty feet exposed quartz conglomerate in irregular vein, six inches thick, 30 to 40 feet from top.
17. Water well, northwest sec. 32, Montgomery twp., Ashland county; well drilled into soft grey sandstone.
18. Northwest sec. 16, Milton twp., Ashland county; sandstone within ten feet of surface of entire knob, thickness of sandstone eighty to ninety feet, water beneath rock.

A correlation of these sections and well records, as shown in Fig. 1, indicates that the Black Hand sandstone in this area is variable in thickness and that the general dip of the top of the sandstone is uniform and approximately nineteen feet to the mile in a direction south of east. The top of the Black Hand is more uniform as measured stratigraphically and the variation in thickness seems to occur at the base of the formation.

From well records in central Liberty township, Knox county, the top of the Black Hand is 1,260 feet above sea level, and the top of the Berea grit 600 feet; in sec. 15, Perry township, Coshocton county, the top of the Big Injun sand is 860 feet and that of the Berea grit 190 feet above sea level. In the twenty-two mile distance across Knox county from west to east the dip of the Black Hand and of the Berea is about nineteen feet to the mile for both and the interval between them is uniformly about 650 feet. Other well records confirm this uniform thickness of the lower Waverly strata in Knox county. In contrast the thickening of the strata between the Berea grit and the Clinton sand in an east-west section across Knox county is pronounced. In western Knox county the interval is slightly more than 1,600 feet and in eastern Knox

grit is designated the Cuyahogan and the facies above the Black Hand the Logan, the thickness of the Cuyahogan is uniform in the area under consideration. Such is not the case with the section of the Logan. In Pike township, Knox county, the Harrison ore, or basal conglomerate, of the Pennsylvanian is found on the surface a mile east and southeast of North Liberty, at a level 180 feet above the Black Hand, at Keller's Rock. On the Wakatomika creek, in sec. 24, Jackson township, Knox county, the basal conglomerate is 110 feet above the top of the Black Hand and 110 feet below the No. 2 or Quakertown coal. The lack of uniformity in thickness of the Logan is general in Knox county.

That the western extent of the Black Hand formed an escarpment prior to glaciation is definitely indicated by the variation in hilltop levels to the west and northwest of Knox county. A study of the topographic sheets shows that the uniform westerly rise of the resistant Black Hand causes the elevated area extending from the highlands around Olivesburg, Weller township, through Richland county to the west of Mansfield, where in sec. 34, Springfield township, the second highest area in Ohio has an elevation of over 1,500 feet, and a bedrock covering of less than 20 feet; thence southerly including Liberty township, Knox county, where the Black Hand is covered with glacial till to a depth varying up to 130 feet. The western extent of the Black Hand is indicated by the irregular line on Fig. 1. Several of the higher areas along the western limit of the Black Hand are outliers due to stream channels having been cut through the sandstone prior to glaciation. Also, in Liberty township, west of Mt. Vernon, the highest area in Knox county is covered with glacial till above the Black Hand, while in Pike township, northeast of Mt. Vernon, over 100 feet of Logan thin sandstones and shales overlie the Black Hand. The persistence, resistance to erosion and the stratigraphic plane of the top of the Black Hand sandstone, as described above, furnishes a definite horizon for the division of the Cuyahogan from the Logan.

In the exposure of the Black Hand, near Millwood, Knox county, where the Kokosing river has cut through the sandstone and weathered vertical sections along the stream show surface erosion indicating possible bedding planes with an inclination of from 15 to 20 degrees to the east.[2] Excavations

[2]Geol. Survey of Ohio, vol. III (1878) p. 337.

in the Millwood sand quarry show no bedding planes with a greater dip than the normal 19 feet to the mile. The cause of these possible bedding planes which incline such an angle may be due to a sloping basin or delta in which the sandstone was originally deposited. While there are indications in eastern Knox county of slight waves of minor anticlines and synclines with crests at intervals of about four miles, as determined by the occurrence of natural gas in the Berea, neither the location

FIG. 2. The face of the sandstone at Rocky Hollow.

of these crests nor the amplitude of the waves would account for the sloping bedding planes of the Rocky Hollow sandstone walls. Fig 2 is an illustration of the face of the sandstone at Rocky Hollow.

The fossils found in the shale-sandstone strata above the Black Hand are:

Crenipecten winchelli.
Conularia sp.
Syringothyris texta.
Camarotoechia sageriana (or sp.).
Productus sp.
Crinid stems.

ADDITIONS TO THE OHIO LIST OF ROBBER FLIES. III. (DIPTERA: ASILIDAE)

STANLEY W. BROMLEY

In my second list of additions to the Ohio Asilid fauna (Ohio Journal of Science, Vol. XXXIV, No. 3, May, 1934, pp. 163–164) the total number for the state was brought to 74 species. During 1934, the following species, collected for the first time in Ohio, were added:

75. *Leptogaster loewii* Banks. Amherst, Lorain County, July, 1934. Three specimens, collected by H. J. Reinhard.
76. *Taracticus octopunctatus* Say. Laurel Township, Hocking County, June 24, 1934. Collected by C. F. Walker and Edward S. Thomas. Five specimens, Bern Township, Fairfield County, July 25–August 1, 1934, collected by Robert Goslin. One had been captured and was being eaten by a jumping spider.
77. *Bombomima affinis* Macquart. Rock Run, Jackson County, September 2, 1934 (one female). Collected by John S. Thomas.

The two latter species were included in my original hypothetical list of species which should occur in Ohio, but it was not until 1934 that they were actually collected. Other interesting finds were two specimens of *Proctacanthus milbertii* Macquart, taken by Mr. H. J. Reinhard at Amherst, in July, and a male of *Proctacanthus hinei* Bromley, collected at Bay Point, Ottawa County, July 8, 1934, by Edward S. Thomas. The latter species is a beautiful large orange-red form that occurs in the sand dune areas about the Great Lakes. Dr. R. C. Osburn collected several at Pelee Point, Ontario, Canada, July 20–30, one of which (a female) had captured and killed a large female specimen of the Carpenter bee, *Xylocopa virginica* Drury.

Most interesting of all was the taking of another specimen of the very rare *Dasylechia atrox* Williston, making the fifth specimen of this species to be found in Ohio. Strange as it may seem, a male of *D. atrox* was found on the steps of the Botany and Zoology Building of the Ohio State University on July 24, 1934, by Mr. C. Vennard. It was presented by the collector to the University Collection which is housed in that building. This widely distributed species, recorded from New York, New Jersey, Pennsylvania, Ohio, Michigan, Kansas, and Utah, is one of the rarest of North American Diptera. Even now there are scarcely more than a dozen specimens in all the collections in the world. Of the five specimens collected in Ohio, one is in the collection of the late Charles Dury, of

Cincinnati, one in the Ohio State University Collection, and three are at the Ohio State Museum. Of the specimens at the State Museum, one was in the James S. Hine Collection, and two were collected by Mr. Charles F. Walker in 1933.

THE FOOD AND BREEDING HABITS OF THE RACCOON

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The awakening interest in fur-bearing animals shown by conservation circles is in keeping with the importance of this group. Attempts to increase the supply and give better protection to those which are becoming less abundant are laudable and deserving of praise. Unfortunately, the sporadic interest exhibited by various game commissions, and their often ill-advised efforts to increase the natural supply, result in dismal failure. This may be attributed, in large measure, to the lack of information available on the habits of the animal in question. Furthermore, conscientious efforts to restore a waning population of any fur-bearer is met with opposition by many hunters, who make the biased, and often unfounded claim that all mammals are detrimental to the well-being of game birds.

With federal attention being directed to the economics of sub-marginal lands, and policies being drawn for future management of the wild life of these areas, attention might well be given to the importance of increasing the fur supply. The intent of this paper is to introduce certain aspects of the life history of the raccoon, *Procyon lotor lotor*, which have hitherto been neglected. More investigations into the habits of our fur-bearers are urgently needed. Such information should be placed at the disposal of the various game commissions, so they might utilize these data in constructing wise and efficient laws.

FOOD OF THE RACCOON

General works of natural history list the raccoon as being omnivorous; fish, frogs, crayfish, insects, small mammals, fruits and berries, nuts and grains, being the more staple foods.

Dearborn (1932) has reported on about 500 raccoon feces examined from Michigan. The most important item, crayfish,

constituted 58.99 per cent of the food, while the remainder was distributed among the following items in the order of their volume: grain, 20.20; fruits, 12.22; insects, 5.34; mammals, 1.11; molluscs, .91; fish, .70; birds, .43; eggs, .05; reptiles, .04; and amphibians, .01. This, ostensibly, represents in large part the summer food of the raccoon and is not a fair index to the average diet throughout the year.

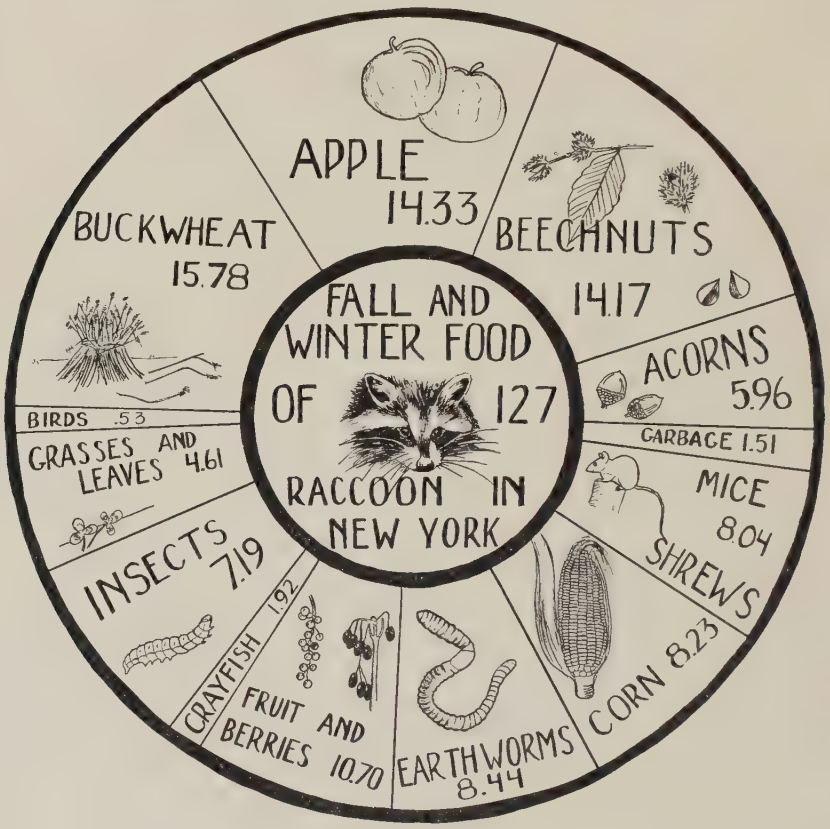


CHART I.

Whitney (1931) has examined large numbers of Connecticut raccoons during the hunting season (October 21 to December 31). Corn, oats, nuts, wild cherries, apples, pears, grapes, crickets, white grubs and trout are the only items he found, with a few exceptions.

From 1927 to 1934 the writer has collected the visceral tracts of 130 raccoons from hunters. These were shot in widely

separated areas of New York. The specimens were collected from November 16th to January 22nd. Distribution by months was as follows: November, 55; December, 51; and January, 24. Of those examined, three were empty.

In the region from which the specimens were collected zero weather is not uncommon during December and January. The occasional thaws and rains of these months, with temperatures of 38 degrees Fahr. to 40 degrees Fahr. may extend over a two or three day period. Raccoon take advantage of these mild spells to venture from the den tree and seek food. Few are hunted at this season. Probably 90 per cent of all the raccoons taken in the state are caught during the first four weeks of the season, which extends, in Western New York, from November 10th to January 20th.

Reference to the diagram will give an index to the types of food eaten by these animals during the late fall and winter. The food is computed as percentage by bulk.

In a study of a wild animal's food, one must remember that the bulkiest food is not necessarily the most important. Often a single item will contribute relatively little to the actual amount eaten, but may, because of its abundance, prove a mainstay to the animal when other food is scarce. An illustration of such is reflected in the following: In the winter food of the raccoon, grasses and leaves form but 4.61 per cent of the bulk eaten, yet were found in 26 stomachs, constituting 20 per cent of all those examined. A discussion of the various foods is in order.

Buckwheat—Buckwheat was found in 20 percent of the animals examined. The grain is gathered from scattered stalks which have escaped the reaper, and the infrequent stacks that are left in the field by the farmer. This waste grain is a boon to the upland game bird and, at the same time, furnishes an important item of food for Ringtail. As much as a quart has been taken from the stomach of an eleven pound raccoon.

Apple—Frequently eaten, being found in 17.4 percent of the stomachs examined. The apples are often eaten in the frozen state and are an important food item in times of general food scarcity. Apple culls are inexpensive and might profitably supplement other food rations on fur farms.

Beechnuts—Beechnuts are the most important food of the raccoon during the fall and early winter, as they are with so many of our mammals, such as mice, squirrels, foxes, bears and even deer. Merriam (1886) has pointed out the importance of the beechnut crop in regulating the cycle of many mammals in the Adirondacks of New York. Quite

probably the crop influences the abundance of birds and mammals wherever extensive stands of beech occur. Beechnuts were found in 21.3 per cent of the animals examined.

Fruits and Berries—Occurring in 20 per cent of the stomachs, berries and fruit play an important part in the dietary predilections of the raccoon. The most important of these are wild grapes, but rum cherries, *Prunus serotina;* Virginia creeper, *Psedera* sp.; nanny berries, *Viburnum lentago;* ground cherry, *Physalis;* and partridge berries, *Mitchella,* are avidly eaten. As these are likewise important foods of game and other birds, plus a host of fur-bearers, including such valuable ones as the red fox and skunk, it would be wisdom to pay close heed to this crop in any program for wild life restoration.

Earthworms—The writer has found no mention in the literature of worms being eaten by these animals. It is truly surprising how important a part annelids play in the menu of the coon. Some stomachs contain remains of a dozen or more nightcrawlers (*Lumbricus terrestris*). What is even more amazing is that the raccoon will find them in large numbers in January. As Whitney has pointed out, the raccoon will emerge from hibernation during warm spells of December and January. After a day or two of warm weather, accompanied by considerable thawing, worms apparently move about and are easy prey for the raccoon. They were found in 19.9 per cent of the raccoons examined.

Corn—Every farmer knows the fondness of the raccoon for corn "in the milk." After it is in the shock, the animal is still partial to maize and feeds on it to a considerable extent. This fondness is reflected in its having been eaten by 12.5 per cent of the animals examined. Hunters know that a good place to start a coon is in the corn field. Corn might profitably be added to the table of captive animals.

Mice and Shrew—Small mammals are eaten as occasion affords. Remains of the meadow mouse, *Microtus p. pennsylvanicus;* deer mouse, *Peromyscus leucopus noveboraceusis,* and the short-tailed shrew, *Blarina brevicauda talpoides,* were found in 17.4 per cent of the animals examined.

Insects—The most important insect taken during the winter months is tipulid larvae. These occur in shallow streams or in the damp leaves bordering such water-courses. Eight animals had feasted upon these, while cutworms, beetle borers, crickets and adult hemiptera were taken less frequently. Insects were found in 18.9 per cent of the stomachs.

Acorns—Apparently the mast of oak is eaten more frequently than my records would indicate, for only 12.7 per cent of the animals had eaten acorns. Coon hunters are generally agreed on the importance of this food which, with beechnuts, forms one of the fattening items which induce hibernation.

Grasses and Leaves—Winter wheat, mosses, small green leaves of *Fragaria,* green hemlock needles and miscellaneous grasses, while not a bulky item, were found in 20 per cent of the animals studied. Like the red fox, green grass forms an important contribution to the winter

dietary of the raccoon. It may act as a tonic, as it apparently does among canines.

Crustacea—Crayfish are eaten as opportunity presents, while an occasional sowbug is consumed. Less than two per cent of the food during the winter, crayfish forms more than half of the food during the summer, according to the observations of Dearborn in Michigan.

Garbage—An occasional raccoon will risk the haunts of civilization to avail itself of the garbage pail and feast on offal and table wastes. Being more timid than the skunk, it does not resort as frequently to this ever ready and usually well spread table. But two animals had eaten garbage.

Birds—Two raccoons had eaten birds and both were woodpeckers (*Dryobates*). It is interesting to conjecture on the method of capture. The most likely is that Ringtail simply reaches in any chance hole it encounters and removes the sleeping bird.

From these observations, it can be seen that certain available foods might profitably be added to the feed of captive ranch-raised animals. Apples, buckwheat, various berries, corn and acorns can be had at a minimum of expense and might lower the cost of maintenance. Furthermore, such natural foods may well add to the lustre and color of the pelts. It would be well worth trying on a small experimental scale to determine the worth of such foods.

REPRODUCTION

In New York mating normally occurs during late January or during the first half of February. The normal gestation period is 63 days. Fur breeders assure me that pregnancy is seldom prolonged as in the mink. After mating occurs, the animals return to their winter sleep. Occasionally, the female fails to mate during the late winter. Such animals may breed during early summer and the young are born in August, according to Whitney (1931). This writer has taken young animals in New England during the fall weighing less than three pounds.

Strangely enough, the early stages of the raccoon have never been described. This is in keeping with the paucity of knowledge on the breeding habits of all our fur-bearing mammals. Careful observations on the early postnatal daily growth of such common species as the muskrat, opossum, fox, and a number of the mustelids, have still to be recorded. It is a virgin field for the young naturalist endowed with patience and enthusiasm.

The following notes, far from exhaustive, are based upon weekly observations of captive animals owned by Dorman Purdy, of Ithaca, N. Y.

AT BIRTH

The new born raccoon is well furred, the fur being particularly long (5 to 10 mm.) over the back and shoulders. The fur is yellow mixed with gray. The skin is black. The external black conch is well developed but unopened and devoid of hair. A small, short, black-haired area in front of the eyes foreshadows the mask which becomes pronounced when 10 or 12 days old. The limbs are well developed, the feet black while claws are light colored, bordering on pink. Facial vibrissae are well developed. The young average 75 grams (2.5 oz.) which is about one per cent of the weight of the mother.

The new born animals keep up an incessant chittering noise when disturbed. The adult carries one, sometimes two, as she runs from the nest box. At times they are grasped about the middle, sometimes by the neck.

ONE WEEK

Face with short fur, mystacial area with strong warty-like protuberances indicating the later appearance of vibrissae. The belly and fore limbs are rather scant haired, while the rest of the body is well furred. No teeth have appeared, eyes still tightly closed. The chittering notes continue and are heard much of the time. Average weight of two, one male and one female, 196 grams (6.5 ozs.).

NINETEEN DAYS

Two of the four young have opened their eyes; all have the external auditory meatus open. The animals average a pound. The leathery soles are jet black. Mask over eye very prominent. A light buffy line running over the eyes back to the ears. Back of the ears black, excepting the buffy tips. The tail has acquired the characteristic annulations, but is still scant haired. Fur heaviest over the nape and shoulders, being a uniform dirty buff tipped with lighter shade. Canines in both jaws erupted. Upper incisors just appearing as knobs while lower are through. With the opening of the eyes the young animals give a muffled bark, like a small dog. They are very active.

THIRTY DAYS

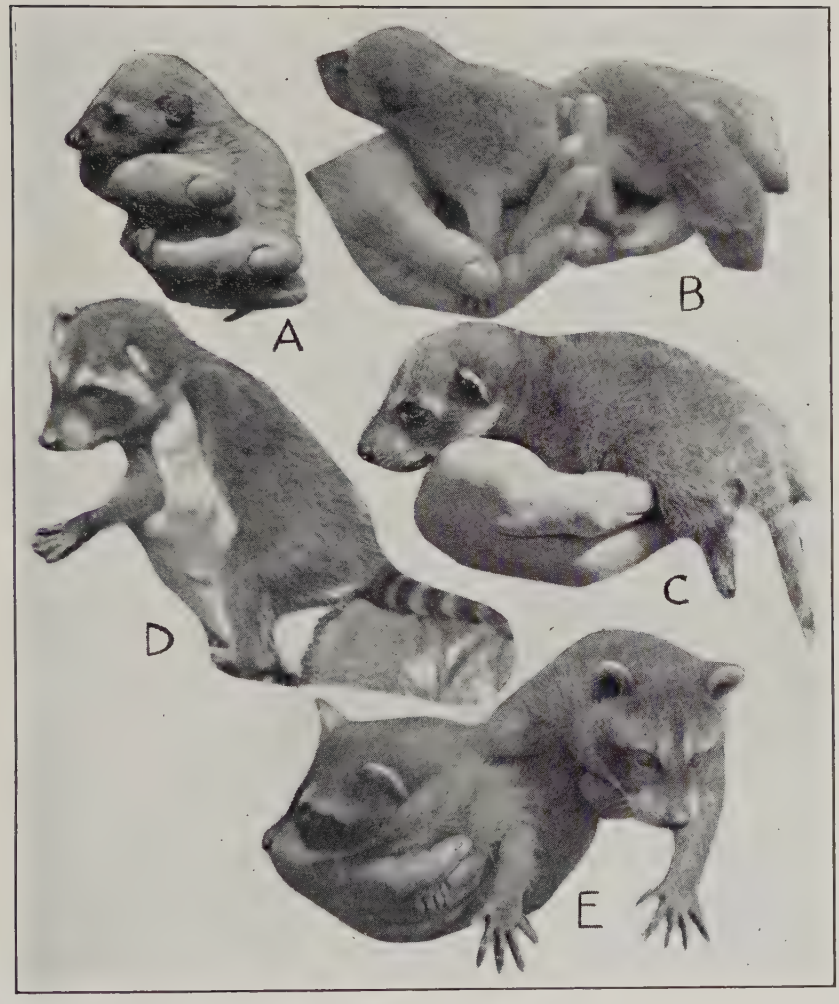
The young average 20 ounces each. Belly well furred, incisors completely erupted, while head remains proportionately larger than the rest of the animal. The youngsters crawl about readily and climb fairly well on a rough surface. They growl and bark with much spirit.

FORTY DAYS

The small coons are being weaned; now weigh 1.5 pounds apiece. Solid food is eaten and the rate of growth is rapidly accelerated.

The young animals at fifty days have apparently not left the nest box of their own accord. They now weigh two pounds, and spit and scratch with much energy.

The young continue with the parent well into the fall, and there is much evidence that, upon occasion, remain with the mother until the mating season approaches. Young animals taken during early November weighed 6, 6.5, 7, 7, 9, 11, 11.5, 12, 12.3, 13, and 14 pounds.



A. Day old raccoon. Note well furred condition. Fingers give index to relative size of the animal.
B. Week old raccoons.
C. Nineteen days old, when eyes first open.
D. One month old.
E. Six weeks old. Average weight two pounds.

IMPORTANCE AS A FUR-BEARER AND GAME ANIMAL

A few abortive attempts have been made by various states to determine the annual numbers of fur-bearers taken within their confines. Numerous difficulties are encountered in any such census. A large percentage of hunters and trappers fail to make a report, or where the census is determined by returns of licensed fur dealers, no account is made of the enormous numbers shipped to dealers outside the state.

Seton (1929) has estimated a primitive raccoon population in North America of 2,500,000. This author further suggests there might possibly have been 5,000,000 over the range; this figure being based on fur trade reports which show that for forty years prior to 1891 about half a million skins were marketed annually from North America.

The writer has carefully studied the fur reports of the various game commissions of a number of states. Where information has been lacking, some of the commissioners have furnished such information not available in the annual reports. When attention is directed to the manner of securing figures on the number of animals taken, it is readily seen that these figures are notoriously inaccurate, and *always too low.*

Based on reports from 1927 to 1934, I have estimated that there are taken each year by hunters and trappers half a million raccoons in fourteen states (California, Indiana, Iowa, Louisiana, Maine, Minnesota, Mississippi, North Carolina, New Hampshire, New York, Oregon, Pennsylvania, Texas and Virginia). These states cover but half of the animal's range in the United States. Furthermore, the area for which I have available figures, does not include such important coon producing states as Ohio, Michigan, Illinois, Oklahoma, Arkansas, and the great southeastern area, which alone encompasses 200,000 square miles of extremely productive raccoon territory. The most important fur-bearer in South Carolina and Florida is the raccoon.

It may readily be seen, then, that the number of ringtails taken annually in the United States may well exceed the million mark. Aside from the pelt value, which probably averaged a $2,500,000 annuity to the hunter over the past decade, the animal furnishes incomparable sport to many thousands each fall.

FUTURE STATUS OF THE RACCOON

The popularity and widespread use of raccoon pelts in the fur trade has increased the demand enormously during the past fifteen years. Drastic reduction of suitable cover, largely due to lumbering operations, has been instrumental in further reducing the habitat of this once plentiful fur-bearer. The most potent agency in depleting their ranks, however, has been the lack of sensible, short seasons, or the entire lack of any closed season for the animal.

One state gives no protection to the raccoon; two give complete protection. Of the remaining states, we find thirty different seasons. These vary in length from the wise November 1–December 15 season, to laws permitting the taking of raccoon over a five and a half month period.

It has been shown that the breeding season of the raccoon in the northern part of its range occurs during late January or early February. Three-quarters of our states permit the taking of ringtails during the breeding season. Fortunately, few animals are taken during mid-winter. The greatest loss occurs during the fall months, and is particularly severe when the season opens before November. At this period the young of the year are not sufficiently strong to make a sustained flight from a well-trained dog, and tree a few minutes after being started. An ideal season, at least in the Northern States, would extend from November 10 to December 31. The hunter, who takes 90 per cent or more of all animals which reach the market, would get in some excellent sport and at the same time be reasonably assured of hunting in the years to come.

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NOTES ON ROOT BEHAVIOR OF CERTAIN TREES AND SHRUBS OF THE ILLINOIAN TILL PLAIN OF SOUTHWESTERN OHIO

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In connection with studies of the vegetation of the Illinoian till plain,[1] certain peculiarities of root systems were observed which appear to be due to local environmental conditions. Furthermore, the adaptability of the root systems there displayed is an important factor in determining the ability of certain plants to occupy these areas.

The Illinoian till plain is a flat or nearly flat upland very imperfectly dissected by streams. In consequence, run-off is slow and drainage conditions poor. The fine impervious soil, a deeply weathered and leached drift, further accentuates the poor drainage conditions. Except in periods of extreme drought, the water table is close to the surface; in wet seasons and almost always in spring, it coincides more or less with the surface. In the shallow depressions, water stands sometimes for many months. Such soil conditions result in poor soil aeration.

Responses in direction of root growth to the poor drainage and aeration conditions are evident in the superficial root systems of many of the plants. The present paper is intended to give an idea of root behavior displayed, but is in no sense a detailed study of root systems. Rather it is suggestive of the importance of root behavior in an extreme environment as a factor in species competition and forest development.

Certain of the trees in wet soil develop swollen bases or buttresses and roots widely spreading at the surface. White elm (*Ulmus americana*) has roots near the surface which arch above the ground in the wettest places. It may also have prominent buttresses which sometimes give a broad pyramidal form to the tree base (Fig. 1B), or which extend out many feet in narrow plank-like projections (Fig. 1A). A grotesque and almost inexplicable form is shown in Fig. 1C.

[1]Forests of the Illinoian till plain of southwestern Ohio. Ecol. Mon. 1936.

The superficial and spreading habit of the roots of beech (*Fagus grandifolia*) is even more pronounced than is that of white elm (Fig. 2A, B). The large spreading roots are at the surface of the ground and even arch above it; a dense mat of fine fibrous roots fills the upper three to five inches of soil. The main roots at the trunk may amount to props elevating the trunk so that at its base it is not in contact with the soil (Fig. 2C). Arching of the main roots at or near the trunk is sometimes seen (Fig. 2D). In situations where the large roots are exposed, beech sends up abundant root shoots. The shallowness of the root systems of beech in wet and poorly aerated soil resulted in high mortality of this tree in depressions in the 1930 drought.

Large sweet gum trees (*Liquidambar styraciflua*) occasionally have superficial roots. In this species there is no accompanying enlargement or buttressing of base (Fig. 1D). Examination of the root system of very young trees shows strong development of laterals and pronounced twisting or curling of the tap root.

The larger roots of red maple (*Acer rubrum*) commonly spread at or near the surface of the ground, though not in as pronounced a manner as do those of white elm and beech.

Pin oak (*Quercus palustris*) develops a strong tap root; even in this species, however, the tap root may become considerably bent or twisted, but fine superficial roots do not develop.

The superficial root habit is assumed partially in response to poor aeration in saturated and water-logged soils. This will not, however, account for such peculiar forms as shown in Figures 1C and 2D; neither will it account for the arching habit of some, unless this position was taken when the water table was much higher than now. Frost action in a fine-grained soil is a factor tending to heave roots and young trees. This is sometimes evident in the case of saplings about one inch in diameter. Hence, while largely a response to soil water and air, the features of tree roots here mentioned may be due in part at least to the heaving action of alternate freezing and thawing.

The assumption of shallow root systems by elm, red maple and beech, particularly, increases root competition and may be a factor in accounting for the paucity of vegetation in the ground layer in communities in which these species are important

FIG. 1. A. Base of white elm showing "plank buttresses." The Thermos bottle gives scale.
B. Pyramidal buttressed base of elm.
C. Base of young elm; no erosion or removal of soil was possible in the situation in which the tree is growing.
D. Sweet gum with spreading superficial roots. Tree in wet soil in beech-white oak-sweet gum community.

FIG. 2. Variations in form of beech.

A. Roots of large tree crawling on surface of ground; these superficial roots afford favorable habitats for a variety of mosses and lichens.
B. Close-up view of arching root.
C. Trunk elevated above forest floor by three large roots.
D. Peculiarly arching roots of beech.

members. In contrast, the greater abundance of shrubs and herbaceous plants in certain pin oak and white oak communities, both primary and secondary, may be due to the lesser root competition in these communities.

Many of the shrubs of the wet flats have superficial root systems. Spiraea bushes (*Spiraea tomentosa*) can frequently be lifted from the ground with almost no effort; most of the roots spread in the shallow layer of leaf litter; few penetrate the mineral soil beneath (Fig. 3). *Ilex verticillata* is similar in root habit (Fig. 4A, B, C). The habitat in which these shrubs commonly grow in the till plain is characterized not only by the high water table and poorly aerated soil, but also

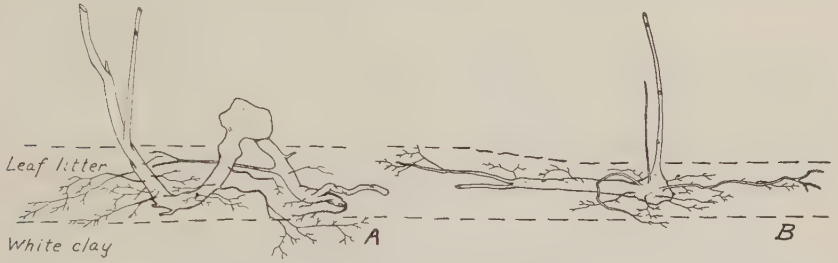

FIG. 3. Root habit of *Spiraea tomentosa*. Roots largely confined to layer of leaf duff on "white clay" or Clermont silt loam.

by the formation of a definite layer of leaf duff of the type described by Romell and Heiberg.[2] It is in this duff that root development takes place. It is possible that the absence of certain of the more characteristic shrubs of the till plain communities from some of the larger areas of the flats may be due to drying out during extreme droughts; the position of the root system makes this highly probable.

Some herbaceous plants in their root systems show a response to soil conditions. Both shallow and penetrating root systems are found. In some, as *Stellaria longifolia*, the roots are in the leaf duff. Regardless of situation, *Gentiana Saponaria* has a deeply penetrating root system. Such plants as *Gnaphalium polycephalum*[3] and *Sabbatia angularis*, both of which have tap roots, assume shallow root systems in poorly aerated soils.

[2]Romell, L. G. and S. Heiberg. Types of humus layer in the forests of northeastern United States. Ecol. 12: 567–608. 1931.

[3]Guhman, Helen. Variations in the root system of the common everlasting (*Gnaphalium polycephalum*). Ohio Jour. Sci. 24: 199–208. 1924.

Peculiarities of root systems are assumed in response to environmental factors—high water table, poor soil aeration,

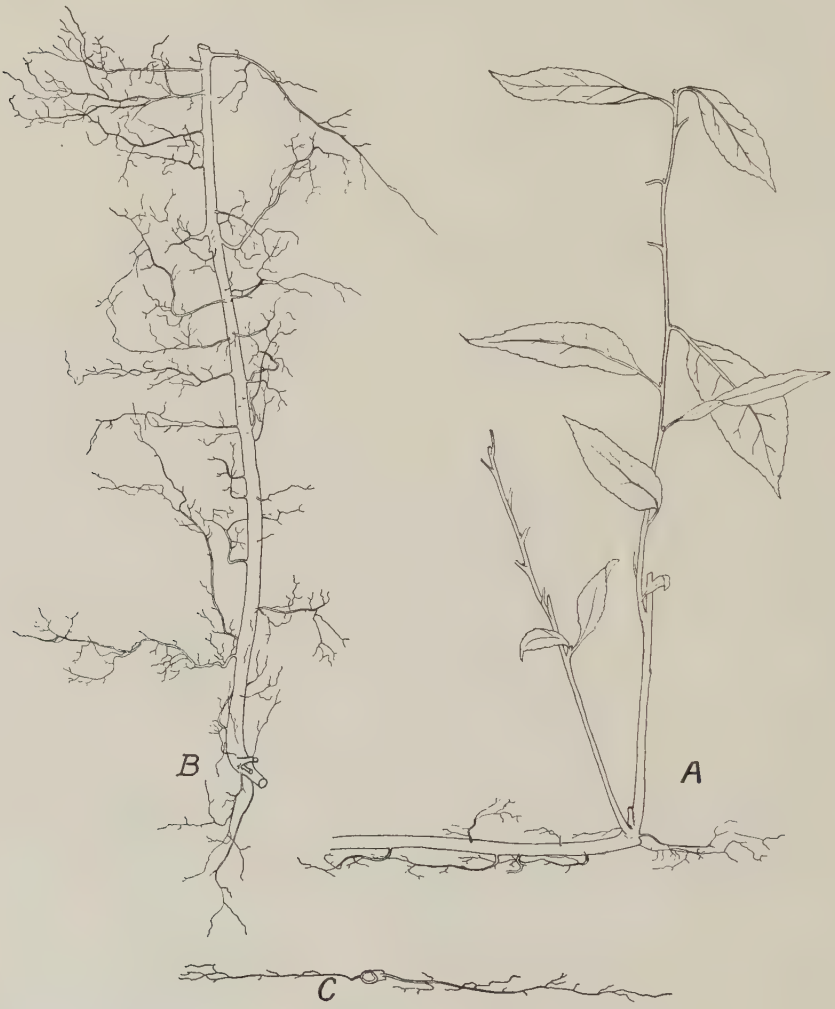

FIG. 4. Root habit of *Ilex verticillata*.
A. General view of root system.
B. Large root as seen from above showing extensive development of laterals all essentially in horizontal plane as shown in C.

leaf duff formation, and occasionally frost action. The assumption of superficial root systems by certain trees increases root competition in surface soils.

THE INHERITANCE OF ALLERGIC DISEASE*

ALEXANDER S. WIENER

Preliminary Report

There seems to be no unanimity of opinion as to the mode of transmission of allergic disease. According to Cooke and Vander Veer (1) and Spain and Cooke (2), allergy is transmitted as a simple Mendelian dominant. In direct contrast, Adkinson (3) maintains that her findings favor a recessive mechanism. Furthermore, Richards and Balyeat (4) suggest that the condition is inherited as a "partial dominant."

An analysis of our own (5, 6) family studies (66 complete families with 250 children), as well as data already published, failed to support either the simple dominant or recessive theory. The dominant theory does not explain why in more than half of the pedigrees both parents are normal. The recessive theory is refuted by the existence of pedigrees in which both parents are affected, yet some of the children are normal.

The author presents for consideration a new theory of heredity of allergic disease. Under this theory, allergic disease is transmitted by means of a single pair of allelomorphic genes, *H* and *h*, where *h* determines allergy, and *H* is the contrasting normal gene. Three different genotypes are possible.

(1) Genotype *HH*—pure normal.

(2) Genotype *hh*—pure allergic. In individuals of this genotype, symptoms of allergic disease appear before the age of ten years.

(3) Genotype *Hh*—The majority of these individuals remain apparently normal throughout life, though they transmit the abnormal gene *h*. Depending upon environmental conditions, a certain proportion will develop allergic disease, but the symptoms do not appear until after puberty.

The existence of two sorts of allergic individuals is supported by their bimodal distribution when classified according to age of onset. Moreover, statistical analysis of the authors' own findings (5) in family studies and data previously published

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lends additional support to the theory. One finding that remains to be explained is the excess of males over females among those developing allergic disease before puberty.

In 55 of the families studied by the author, the simultaneous heredity of the allergic disease, the blood groups, MN-types, and eye color were presented. Statistical analysis failed to reveal any evidence of linkage among the genes determining these traits (6).

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Ovulation in Women

This volume, one of the series on Medical Aspects of Human Fertility published under the auspices of the National Committee on Maternal Health, is an extremely well-written account of the time of ovulation, the possible time of conception, and the "safe period" in women. It is entirely free from religious prejudice, or bias of any sort. The style is delightful and the analysis keen and critical. A great deal of factual and experimental material, both on human and monkey subjects, is presented and discussed. The book is not too technical to be read and understood by the layman, yet is of absorbing interest to the biologist. The evidence for mid-interval ovulation for women, and the relatively safe period outside of days 8 to 21 of the cycle, while not complete, is considered the most plausible at present.—L. H. S.

Time of Ovulation in Women, by Carl G. Hartman. x+226 pp. Baltimore, The Williams and Wilkins Co., 1936. $3.00.

The Alcohol Problem

Not a diatribe, not a preachment, not a sentimental fable, not a pseudo-scientific emotional appeal, but a brief and calmly scientific discussion of the physiological effects of alcohol upon the human body is this little book which represents one of the newer trends in moral education wherein the traditional dictum of "Thou shalt not!" is replaced by "These are the facts. What should you do about them?" The author presents these facts in story form expressed in simple language, which in no way lessens the accuracy of the material presented, and in lucid, flowing, and at times humorous style which should appeal both to the youths of grades 7 to 12, for which it is primarily intended and to grown-ups as well. The author wisely avoids getting too much involved in the controversial social aspects of the problem, but he has written a straight-forward and honest account in which American youth is urged to form personal judgment on the basis of widely accepted facts.—B. B. M. Meyer.

Alcohol Talks to Youth, by Howard E. Hamlin. 63 pp. Columbus, Ohio, School and College Service, 1935. $0.24.

NEW TABANIDAE (HORSEFLIES) WITH NOTES ON CERTAIN SPECIES OF THE LONGUS GROUP OF TABANUS[1]

CORNELIUS B. PHILIP

While examining representative material of western species of horseflies in the collection of the late Professor J. S. Hine, it soon became evident that the status of some species could be clarified only by a revision of certain species related to the difficult *longus* group of *Tabanus*. From time to time, various students of the family have contributed data on the group, including Hine himself, and the latest contribution is that of Fairchild (1934). The present notes are submitted in the hopes of providing additional diagnostic information without any pretense to a complete treatment of all the related slender-bodies species in North America.

The author is indebted to the authorities of the Ohio State Museum, particularly Mr. Edward S. Thomas, for permission and facilities to study Professor Hine's extensive collection and to make comparisons with his own; also to Dr. Alan Stone of the U. S. National Museum for generous comments and data as cited below.

T. longus O. S. Specimens are before me from Pennsylvania, Ohio (1 ♀, Lancaster, by Bequaert), Kentucky and Arkansas (Yell Co., by Schwardt). There seems to be considerable variation in robustness of the palpi and of the body in general. The Arkansas specimens are largest (15 mm. in one instance) with elongate palpi attenuated for nearly half their length, a distinct dorsal prominence on the antennae and the abdomen not narrowed posteriorly, the 6th tergite reduced in depth and not as elongated as in typical *longus;* these are probably distinct and more closely related to "*T. sp.*" to be described by Stone. The Kentucky specimens, on the other hand, show the usual body form, but the palpi are relatively short and somewhat incrassate to the bluntly rounded apices. It appears to be a late summer species, like *sackeni*, seldom appearing before August.

T. sackeni Fairchild. This author, in 1934, correctly separated this species from *T. longus*, recording it from as far west as Missouri and Ohio. The writer had also discovered its presence among Hine's material and noted but one specimen of true *T. longus* from within Ohio in a considerable series of this species (identifications confirmed

[1]Contribution from Rocky Mountain Laboratory, United States Public Health Service, Hamilton, Montana.

by Dr. J. Bequaert). Additional records include Arkansas (specimens received from H. H. Schwardt) and Kansas; while Stone adds Va., Ind., and Okla. It has been taken in Ohio between July 23 (Thomas) and as late as September 7 and is apparently not uncommon. The eyes of the female (relaxed) show traces of two greenish bands on a purple ground.

The male (which Fairchild apparently lacked) is easily associated.

Allotype—Length, 14 mm. Head subhemispherical, area of enlarged facets well marked, occupying almost three-fourths of the total area. Antennae very slender, about half the width of those of the ♀, but the elongate shape characteristic; red, the annuli sharply black. Palpi very slender, second joints about two and one-half times as long as broad, covered with long, white hairs and a few scattering black ones. Thoracic lines not as distinct, abdomen more slender, rather pointed, otherwise the abdominal pattern, leg colors, vestiture and completely hyaline wings compare typically with the ♀. "Neotoma," Hocking Co., Ohio, July 24, 1932. Edw. and John Thomas. In the collection of the Ohio State Museum.

Additional males, one each from Onaga, Kansas, July 21, 1901, in the same collection, and from Hinckley, Medina Co., Ohio, August 24, 1904, in the collection of the author. These are probably the males mentioned by Hine (1914) under his form 1 of *longus*.

T. fulvulus Wied. Typically, the annuli of the antennae, femora, fore tibiae distally and tarsi are blackish. Stone considers as true *fulvulus* only the variant with yellow face, palpi and pleurae described by Osten Sacken in his "observation" (1876, p. 452). The degree of infuscation of the appendages varies so markedly as to suggest a composite species, and certain specimens from the South are markedly pallid in this respect, as pointed out by Hine (1914).

Insufficient material and some intergradation among the females, especially in color intensity, makes it unwise to treat this form in more than a varietal sense at present.

Var. *pallidescens* n. var. Female—Length, 13.5 mm. Differs from typical *fulvulus* in having front more distinctly convergent below, the callosity "faded brown," more elongate and not separated from the eye margins by narrow pollinose lines; face below the insertion of the antennae whitish pollinose and pilose with hardly a suggestion of buff, palpi pale creamy; thorax light yellowish instead of golden, pleurae sharply white pollinose and pilose, legs practically concolorous, pale reddish, darkening slightly on the apices of the fore tibiae and on the fore-tarsi, and some blackish hairs on the tips of the hind tibiae; the wings more hyaline, the dilute yellowish along the costal margin hardly discernible; the abdominal pattern is essentially the same but less dark caudally.

Male—12 mm. Eyes bare, dark brownish, area of enlarged facets large, very pronounced. Antennae entirely red, slender, with a distinct tooth, the annuli about two-thirds length of the third joint proper. Palpi pallid, pointed apically with long white hairs. Thorax yellowish on the disc, pale grayish laterally and ventrally, unstriped. Legs concolorous reddish, a little darker distally on the front pair. Costal

cell of wings dilute yellowish. Abdomen orange-yellow, pattern indistinct.

Holotype, female. Blue Mts., Miss., June 10, 1914, H. H. Carter. In the collection of the author.

Allotype, male, Starkville, Miss. "T. C.," May 31, 1921. In the collection of the Ohio State Museum.

Paratype females. Tenn., 1; Ark., 1; Ga., 5; Miss., 1, and La., 5. In the above collections also.

A specimen compared by Hine with the type of *T. fulvofrater* Walk. has red antennae, but he says (MS notes), "The (type) specimen is much soiled and antennae broken," and his other comments indicate the name is hardly available for this pallid variety. The male with all red antennae studied by Osten Sacken may be this form and also perhaps the females he describes with pale face, palpi and pleurae and "brownish yellow" femora; Fairchild does not include a statement regarding Osten Sacken's original three specimens in his redescription of the Mus. Comp. Zool. material.

T. sagax O. S. The type of *T. baal* Twns. (examined through the kindness of Professor Beamer of the University of Kansas) was greased and when cleared is a well preserved specimen of *sagax* with gray front, cheeks, pleurae and broad, abdominal stripe. *T. dawsoni* Phil. is also a synonym.

Two rather definite forms have been regarded as *sagax* by Hine and others, the typical one being rather robust, 13–15 mm., the front of the female about three times as tall as broad, the 3rd antennal segment elongate (length is to breadth about as 3.5 : 1), the annuli less than half the total length of the segment (1 : 2.5), the palpi yellowish, the abdomen chiefly reddish yellow with a wide grayish pollinose, mid-dorsal stripe. The other form is darker with a narrower front and will be described later by Stone and is the one, comparison with which was responsible for the establishment of *dawsoni*.

The male of the typical form has not heretofore been described.

Allotype—Length, 13.5 mm. Area of enlarged facets of the eyes not pronounced but definitely delimited, about two-thirds of the total area. Antennae of the same elongate shape as in the ♀, but a little more slender, red, the annuli sharply black. A few scattering, long black hairs among the white pile along the facial margin of the eyes and on the underside and apex of the second palpal joints. Latter rather swollen, about twice as long as wide, pale yellow. Compared to the ♀, the whole body is covered with longer pile, that on the pleurae more yellowish, and the abdominal pattern rather indistinct with a fulvous suffusion, the mid-dorsal black crescents hardly evident except by dark hairs, the characteristic mid-dorsal stripe evident although creamy instead of gray pollinose, and the elongate, black, integumental spot in the middle of the second segment (usually obscure in the female) pronounced. Carlisle Junction, Pennsylvania, June 27, 1917, J. N. Knull. In the collection of the author.

T. longiusculus Hine. Although the describer compared this with *longus* as "smaller and darker" (he undoubtedly had then unknown

T. sackeni confused with the latter) it nevertheless bears a striking general resemblance to true *T. longus* O. S. in size and color. The front in this is somewhat narrower, however, and the callosity perceptibly taller than wide; the antennae are a brighter red and the third segment chunkier, while there are darker shades on the femora accentuated by blackish hair at least dorsally on the last two pairs, best emphasized by end-on view. These hairs in the *longus* examined have been almost entirely pale. Infuscation of the femora, especially of the bases of the two hind pairs described by Hine as "almost black," varies somewhat and in two of the eight co-types seen by the writer, is almost evanescent. In one of the co-types otherwise comparable, the third antennal segment is drawn out resembling that of *sagax* in shape.

A male taken by the original donor, A. H. Manee, in the type locality a year after the description appeared, is here described.

Allotype—Length, 12 mm. Easily associated with the ♀, but the body, legs and wing veins not so dark, nearer a pure brown. Eyes with area of enlarged facets distinct, but not as pronounced as seen in some glabrous-eyed species, occupying slightly more than half the total area. Antennae bright red, annuli sharply black, narrower than in the ♀. Second palpal joints pale creamy, about twice as long as thick, distinctly downward pointed apically, with white and black hairs intermixed, white only on the basal segment. Proboscis very short. Thorax with faint brownish lines and appressed yellowish hairs among the dense, upright, smoky ones on the disc. Entire venter with less of the pronounced frosty pollen of the ♀. Legs brownish, darker distally and on the femora because of rather dense black hairs over the whole fore femora and dorsally on the last two pairs. Abdominal pattern typical, but the stripe and spots yellow rather than gray.

Southern Pines, North Carolina, May 22, 1908. In the collection of the Ohio State Museum.

Two females (one with nearly concolorous legs) apparently from the original Georgia series, were also studied in the University of Kansas collection bearing the photographic labels of "*T. longulus* det. by Hine." The species has been reported from Louisiana (Jones and Bradley).

T. zythicolor n. sp. (Latin, beer-color). Heretofore placed with *T. longus* O. S., but the entirely pale red, relatively shorter antennae, average smaller size (9.5 to 13 mm.) and lighter brownish-red color, especially of the thorax, with a complete yellowish suffusion of the wings, and the narrower front with lack of connection between the yellowish frontal callosity and the dark brown, ovate median callosity above in the females are distinctive.

Female—Length, 13 mm. Eyes glabrous, indications of two stripes (relaxed). Front parallel sided, about four times as high as wide, yellowish pollinose, the callosity fulvous, quadrate, occupying the full width of the front, a little taller than broad and widely separated from the small, dark brown ovoid median callus. Subcallus fulvous pollinose, face and cheeks creamy, with pale hairs; palpi about three-fourths of the length of the stylets, pale yellowish with sparse black and white hairs intermixed, moderately swollen basally. Antennae, including annuli, entirely light reddish, rather broad, little excised. *Thorax*

pale brownish-red, with appressed, pale golden hairs and practically immaculate. Legs pale reddish. Wings with costal cell yellowish and a paler suffusion over the entire surface. Halteres brown. *Abdomen* elongate, of a light reddish-brown ground color, with narrow, pale incisures and three rows of triangles, the median triangles narrow, but not acuminate anteriorly, widening abruptly on the posterior margin; the appearance is thus a narrow median pale stripe with widened portions barely connecting across the posterior segmental margins with the rounded pale lateral spots. In certain lights, the latter hardly touch either margin. Venter pale reddish.

Male—Length, 12.5 mm. Essentially similar to the female but a trifle darker brown over the whole body including the appendages, except the palpi which are pale yellow and rather slender, bluntly rounded apically, about twice as long as thick. Fore-tarsal claws subequal, black. Not much difference in the size of the eye facets.

Holotype—Female, Oakdale, North Carolina, August 22, 1902, F. C. Sherman.

Allotype—Male, Cape Charles, Virginia, July 1–20, 1933. Dwight Buchanan. Both in collection of the author.

Paratypes—Two females, Raleigh, North Carolina, July 18 and September 2; 1 female, Brinkleyville, North Carolina, August 6; 1 female, Princeton, North Carolina, July 28; 1 female, Lagrange, North Carolina, mid-July; 10 females, Mimsville, Georgia, July 7 to September 6. In the collections of Ohio State Museum, Museum of Comparative Zoology, Cambridge, Mass., U. S. National Museum, and Rocky Mountain Laboratory at Hamilton, Montana.

Little variation is to be seen except in size and in distinctness of the abdominal pattern according to the preservation of the various specimens. Stone adds the states of Va., S. C., Tenn., Ala., Fla., Ark., La., and Okla.

T. gracilis Wied. Most of the specimens studied from North Carolina, Florida and Louisiana have antennae entirely bright reddish, but occasionally there is a dark-brownish suffusion distally which involves the whole third joint as in a specimen kindly compared for me with the type by Dr. H. Zerny, of the Vienna Natural History Museum. The species seems otherwise quite uniform.

T. abactor n. sp. (Latin, cattle-thief). Has been confused heretofore with *T. erythraeus* Big. (*T. rubescens* Bell., syn.[2]) of Arizona and Mexico. The abdomens of both have somewhat the same light chocolate-brown ground color with three rows of prominent pale-brown triangles reaching almost or quite across the segments, but this color occupies the thorax of the females as well in the present species, and

[2]The synonymy is in manuscript of the late Professor Hine who studied Bigot's type at the British Museum; but the specimen compared by him is actually *T. abactor*. Bellardi specifically mentions the enlarged first antennal segment in his type, and Austen writes of this segment in Bigot's type, "unusually incrassate, as described in your letter, and projects like a hood above the small second segment." Hine's synonymy is, therefore, correct, although his homotype is *abactor*. *T. rubescens* Bell. is preoccupied by *rubescens* Macq. while *T. erythraeus* Big. (type in poor condition) has page priority over *Atylotus erythraeus* Big. from the Argentine.

the glabrous eyes, normal rather than swollen first antennal joints, presence of a faint cloud at the bifurcation of vein R5 of the wing, and the larger frontal callosity of the female will differentiate it.

Female—Length, 14 mm. Eyes naked, with two green stripes on a purple ground (relaxed). Front grayish pollinose, rather narrow, very slightly convergent below, the dark brown callosity occupying its full width and tapering abruptly into a narrow line above; on either side of the latter a patch of dark brown pollen with blackish pile, which is obsolescent when viewed from above. Subcallus and palpi pale-creamy pollinose, the latter tapering gradually and not quite as long as the stylets, covered sparsely with appressed black and white hairs; face and cheeks whitish pilose and pollinose. Antennae dark reddish, the annuli black, and the third joint broad, chunky, with little excision. *Thorax* and scutellum brown, covered with appressed gray hairs and indications of four brown lines almost the full length of the disc. Antealar tubercles with fine black and white hairs intermixed. Pleurae and fore coxae creamy-brown pollinose and whitish pilose. Fore legs with femora, distal half of tibiae and tarsi blackish-brown; front tibiae basally and two hind pairs of legs reddish-brown. Halteres brown, yellowish on the disc. Radial sector of wings not appendiculate, the stigma pale brown, and the costal cell and cross-veins are very faintly tinged with yellow, in addition to the faint cloud at the bifurcation of R5. The abdominal triangles completely divided by the dark brown intervals, i. e., not connected across the incisures, the median triangles equilateral and paler than the lateral, semi-rhomboidal spots. Venter reddish-brown, darker toward the tip, with a wide median stripe of minute black hairs its full length.

Male—15 mm. A little darker than the ♀, especially on the thorax, area of enlarged facets not as marked as in some glabrous-eyed species, a single green band across the purple area of small facets. Palpi fulvous, rather short, about twice as long as thick. All femora blackish. Otherwise as in the female except for the usual sexual differences.

Holotype, female, Eastland Co., Texas, May 27, 1921, Grace O. Wiley. In the collection of the author.

Allotype, male, Kerryville, Texas, June 19, 1908; F. C. Pratt (Bishopp No. 5410). In the collection of the Ohio State Museum, Columbus, Ohio.

Paratypes—One male, same data as holotype, and one female, same data as allotype (August 5), in the collection of the author; 18 females from Eastland County, and from Austin, Brownwood, Kerryville, Dallas, Doss, Uvalde, Batesville, Sonora, Bardsdale, Lackey, Bunt, San Marcos, Hacienda, Mason, Regan Wells and Con Con, Texas. Dates are fairly distributed between May 27 and September 20; one female from Sonora is labeled October, 1921. In the collections of the Ohio State Museum, U. S. and Canadian National Museums, Museum of Comparative Zoology, University of Kansas, California Academy of Sciences, and the Rocky Mountain Laboratory, U. S. Public Health Service, Hamilton, Montana. One male, Pearsall, Oct. 9, and 3 females, Johnson Co., July 1, Texas Coll. Reinhard, in Univ. of Texas Collection. Length, 12 to 15 mm.

Some variation is seen in abdominal coloration of the paratypes where a smoky suffusion may spread forward from the tip involving especially the venter.

The species is some like *T. sackeni* Fchld., but the abdominal triangles are more pronounced and angulate, the third antennal segment is wider and shorter, the front of the female is less convergent, the callosity merging broadly with the median callus above, and the fore femora of the female and all femora of the male are dark brown; the wings of *T. sackeni* have no traces of clouds on any of the crossveins.

The specimens from Texas referred to by Osten Sacken (1876, p. 448) in the last paragraph under *T. longus*, and by Fairchild (1934, p. 143) under *T. fulvicallis* probably represent this species. Stone lists this species from Kansas and Oklahoma in addition to Texas and comments that the "abdomen of *erythraeus* is distinctly more orange-brown than in *abactor* and the colors more contrasted" in his considerable series.

Professor Sanborn, of the University of Oklahoma, informs me this species is very amenable to confinement and most useful in their transmission studies of anaplasmosis in cattle. Specimens from him are *T. abactor*, and it seems likely the "*T. gracilis*" reported by Sanborn et al. (1930) were actually *T. abactor*, since the former occurs only rarely as far west as Louisiana. He has taken it from mid-May to mid-September and observes it to be their most troublesome species, as many as three dozen being seen on an animal at one time in mid-season. Their experiments (unpublished) indicate this species as a potential vector of the disease.

Since Fairchild (1934) overlooked including his intended key to the *longus* group, an analytical dichotomy is here appended to include also related species with elongate, brownish bodies and three rows of abdominal spots treated above.

1. Legs practically concolorous, brownish-red (fore tibiae and tarsi sometimes darkened distally) 5
   Legs with at least the fore femora almost black or decidedly darker than the fore tibiae basally; legs therefore really bicolored 2
2. Wings with faint clouds on outer cross-veins and costal cell hyaline; lateral abdominal spots angular, semi-rhomboidal; median callus linear, not widened above its connection with the frontal callosity; fore legs only (♀) bicolored ..... **abactor** n. sp.
   Wings hyaline with yellowish costal cell; lateral abdominal spots rounded (except *texanus*); median callus usually widened above or disconnected from callosity; all femora darkened at least basally 3
3. Lateral abdominal spots angular and continuous, the dark intervals not curved behind; front of female broad, the callosity quadrate .. **texanus** Hine
   Lateral abdominal spots rounded, isolated at least inwardly and below by paired crescentic dashes; front of female moderately broad or narrow, the callosity usually plainly taller than broad 4
4. Front of female narrow, somewhat convergent below, the callosity small; thorax essentially unstriped; body, including face and palpi, chiefly yellow ..... **fulvulus** Wied.
   Front of medium breadth, parallel-sided, the callosity relatively large; thorax distinctly lined; body chiefly light brownish, the face and palpi whitish ..... **longiusculus** Hine
5. Wings, including costal cells, hyaline 6
   Wings, with at least costal cells dilute yellowish 7

6. Third antennal joint elongate, red, the annuli sharply black; front of female convergent below, frontal callosity separated from the median, **sackeni** Fchld.

Third joint short, compact, predominately black; front of female narrow parallel, frontal callosity continuous with a narrow, median line above, **fulvicallus** Philip

7. Antennae entirely red, occasionally brownish..... 8
Antennae black distally, at least the annuli..... 10

8. Thorax unstriped, dusty golden pollinose; front of female narrow, convergent below, the callosity small and elongate, **fulvulus** var. **pallidescens** n. var.

Thorax brown, more or less gray striped; front parallel-sided, the callosity relatively larger..... 9

9. Abdominal triangles angular, the central row large, acuminate just before the margin of each segment; the front of female broad, the calli usually connected.....**gracilis** Wied.

Abdominal spots rounded laterally, the central row or triangles attenuated anteriorly on each segment forming a narrow, continuous gray stripe; front moderate, the calli not normally connected....**zythicolor,** n. sp.

10. Abdominal pattern chiefly brown, rather dark, the mid-dorsal row of connected gray triangles forming a narrow stripe; thorax usually distinctly gray striped.....**longus** O. S.

Abdomen chiefly yellow, or light reddish, the median gray stripe or yellow triangles frequently broad; thorax not or imperceptibly lined... 11

11. Abdomen usually reddish yellow with a broad, pale pollinose, middorsal stripe its full length, the lateral spots indefinite; 3rd antennal segment elongate, the basal prominence hardly perceptible; front of female about three times as high as inferior width.....**sagax** O. S.

Abdomen usually yellowish, with paired, brownish dashes enclosing a rather narrow yellow stripe; 3rd antennal segment with basal angle more distinct; frontal height of female usually four times its width, **"T. sp."** (to be described by Stone)

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Personality

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Personality, by Harold V. Gaskill. vi+50 pp. New York, Prentice-Hall, Inc., 1936.

THE GROSS ANATOMY OF THE ALIMENTARY CANAL OF SOLUBEA PUGNAX (FAB.) (HETEROPTERA, PENTATOMIDAE)

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At the present time the alimentary canal of the Heteroptera has been little studied. In view of this fact and because of the confusion which has arisen in the terminology and the inaccessibility of the more important papers to most students, a short paper dealing with the gross anatomy of the canal of one of the members of this order and bringing the more important facts together seems avdisable.

The writer wishes to express his appreciation to Dr. C. H. Kennedy, of Ohio State University, for his advice during the course of this rather limited work and in the preparation of this paper, also for access to papers in his private library which otherwise would not have been available.

Stomodeum—The salivary pump opens into a long semi-transparent oesophagus (Fig. 1, OES) which extends from the anterior part of the head, passing between the rather large circum-oesophageal connectives and to about the middle of the prothorax.

Mesenteron—The oesophagus opens into a rather large first stomach (Fig. 1, 1ST. S), which extends posteriorly as far as the third abdominal segment. This was termed the crop by Malouf (1933), "premier poche de ventricule chylifique ou stomac," by Dufour (1883) and the first stomach by Glascow (1914). Malouf (1933) states that in *Nezara viridula* L. the oesophagus and crop have similar histological characters, there being "an innermost layer of folded epithelium composed of cubical cells and lined by a thin internal intima." However, he also states that "External to the epithelium is a layer of circular muscle fibers. External to these is a layer of longitudinal muscle fibers; while enveloping all is a nucleated peritoneal membrane." Malouf apparently has made an error in describing the muscles of this region because Harris, in an unpublished thesis, has shown that the longitudinal muscles in *Murgantia histrionica* are surrounded by a layer of circular muscles in the oesophagus. He also shows that in the "crop," as termed by Malouf, the longitudinal layer is external to the circular layer. Malouf has evidently interpreted some other structure as the intima in this organ. Ancona (1932) figures a long structure similar to this in *Alizires taxcoensis*, a Mexican species, which he divides into three parts—the "proventriculo," the "intestino medio" and "estomago." In the specimens of *Solubea pugnax* examined this organ varied considerably

in shape, apparently due to the varying food content. No structure was found which could be called a proventriculus. It is probable that

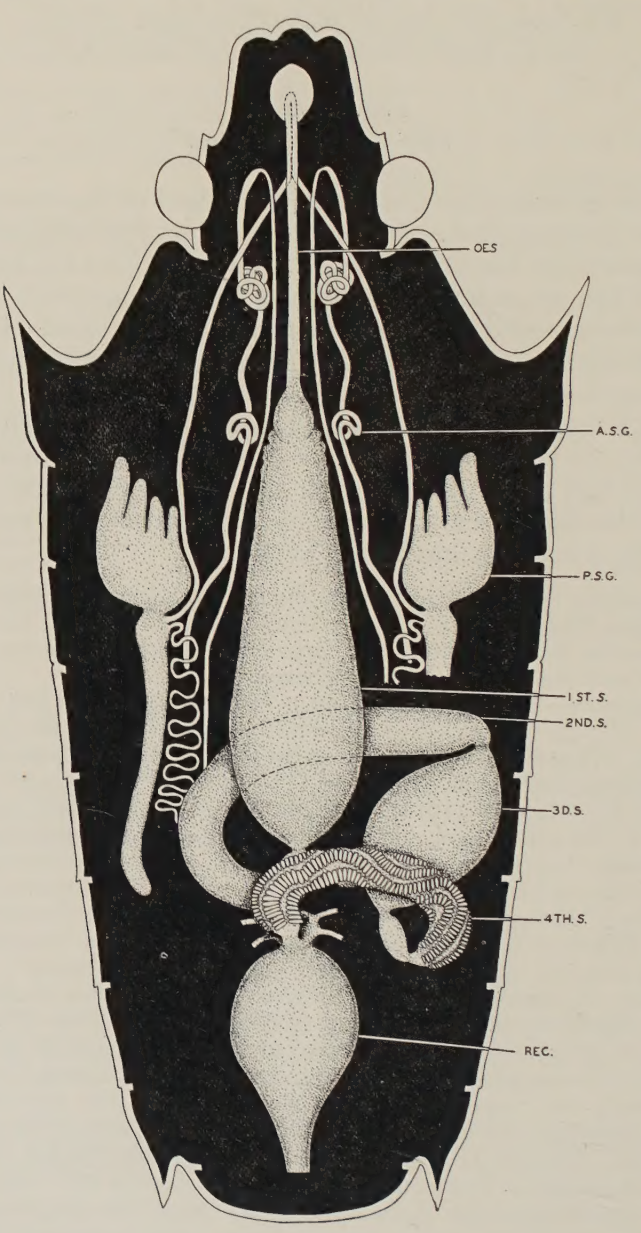

FIG. 1. The gross anatomy of the alimentary canal of *Solubea pugnax* (Fab.).

Ancona misinterpreted this organ when he divided it into a "proventriculo," an "intestino medio" and "estomago."

The first stomach, after a distinct constriction, passes into a tubular organ, the second stomach (Fig. 1, 2ND. S.) which turns dorsally and then anteriorly and ventrally, passing in its normal position under the first stomach. This organ has been designated as the "true first stomach" by Malouf, the "portion filiforme" by Dufour, "intestino posterior" by Ancona, and the "second stomach" by Glascow. After a distinct constriction it turns abruptly posteriad and passes into a globular organ, the third stomach (3D. S.). This organ is the "second stomach" as termed by Malouf, the "second poche gastrique" by Dufour and the "third stomach" by Glascow. This globular portion tapers posteriorly from the middle and passes into a very short organ which has been termed the "third stomach" by Malouf, "col de cette poche" by Dufour, while Glascow combines it with the caecal part of the mesenteron into the "fourth stomach." In some of the specimens examined this was slightly swollen, while in others it appeared as a mere tube. Malouf states that the first, second and third stomachs, according to his terminology, have the same histological structure. He states that "the muscle fibers (as in the stomodeum) are spaced from one another. The circular layer is external to the internal layer." This arrangement is also the opposite to that usually found in the mesenteron of insects. Harris shows the longitudinal muscles external to the circular muscles in *Murgantia histrionica.*

The fourth stomach (Fig. 1, 4TH. S.) or caecal part turns dorsad from the third stomach of Malouf, makes somewhat of a loop and passes into the dorso-posterior region of the "ilium." It is apparently composed of four rows of plate-like structures surrounding a tube. Malouf states that "The lumen formed by the inner faces of the caecal discs is not lined by the epithelium. An inner membrane lines the lumen. Into the extreme posterior portion of the fourth stomach the circular and longitudinal muscles of the rectum extend." Harris states that epithelial cells are present in *Murgantia histrionica.*

Proctodeum—The fourth stomach passes into the "ilium" on the dorso-posterior side.

The "ilium" is a small knob-like structure on the anterior end of the rectum. A pair of rather large Malpighian tubules are inserted on each side of it. The Malpighian tubules are rather long and form an entangled mass in the dorsal part of the body cavity. They lie in the region of the second, third and fourth abdominal segments.

The rectum (Fig. 1, REC.) is a rather large membranous-like organ which extends forward to the posterior part of the third abdominal segment. It becomes narrower in the fifth segment and extends to the anus as a narrow tube.

Salivary Glands—There is a pair of principal salivary glands (Fig. 1, P.S.G.) which lie dorso-lateral to the "crop" of Malouf, one on each side. The anterior lobe is somewhat hand-shaped, having four distinct finger-like projections on the anterior end. The posterior lobe is tubular and may extend posteriorly to the anterior part of the third segment. At the juncture of the two lobes in each gland, there arise the salivary

ducts which extend forward and after passing around the commisure between the sub-oesophageal ganglion and the first thoracic ganglia come to lie beside each other, passing forward and emptying into the ventral side of the salivary pump. In one specimen these tubes, after passing around the commisure, converged and lay parallel to each other for a short distance after which they diverged and led to the principal salivary glands. From each gland just posterior to the salivary duct an accessory salivary gland (Fig. 1, A.S.G.) arises and extends posteriorly and somewhat ventrad reaching almost to the end of the posterior lobe of the principal gland. After folding upon itself several times it turns abruptly anteriorly. It runs forward to the posterior part of the head where it turns posteriorly and enlarges to about twice its size. It makes several convolutions in the anterior part of the prothorax and then runs posteriorly to approximately the juncture of the pro- and mesothorax where about two more convolutions are made, after which it runs more or less as a straight tube to the posterior part of the metathorax.

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FIG. 1. The gross anatomy of the alimentary canal of *Solubea pugnax* (Fab.)

Tectonics

For the past three decades E. B. Bailey has been associated with tectonic research, belonging to the group led by Peach and Horne and Clough. His various works are well known to students of structure, especially those dealing with the Scottish Highlands. It is a pleasure to have before us a series of essays on tectonics. These deal largely with Alpine tectonics. In the twelve chapters the author reviews tectonic discoveries from 1775 to 1893, and then deals with the works of various sarcavts of the Swiss Alps, the Pre-Alps, the Alps of the Rhone sector, the Pennine Alps and the Window of the Hohe Tauern. Many of the various papers of Marcel Bertrand on the structure in Provence are abstracted, and finally there is considered the work of Gavarnie in the Pyrannees.

These essays were started in 1924 and have been completed during the last decade, so that in some of the earlier ones the recent advances in tectonics are not included. Professor Bailey has given us a great mass of information collected from numerous sources, larded with his critical observations, and presented in his condensed and clear style. For the English-speaking student it represents a valuable contribution. Not only does it give the important facts of tectonic researches without necessitating the reading of innumerable French and German articles, but also gives the delightful interpretations of the author. The numerous line cuts and maps are well-chosen and greatly help the understanding of the obscure and difficult points in the structural discussions.—WILLARD BERRY.

Tectonic Essays, Mainly Alpine, by E. B. Bailey. ix+191 pp. New York, The Oxford University Press, 1935.